~~Final~~ Work Plan

Indoor Air/Vapor Intrusion Removal Site Evaluation and any Necessary Removal Action

Signetics Site

Sunnyvale, California

Date Published: ~~298 May 2020~~29 May 2020

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

John W. Hawthorne

~~2/3/2020~~5/29/20

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______________ Date

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
1,1,1-TCA	1,1,1-trichloroethane
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
AMD	Advanced Micro Devices
ARAR	Applicable or Relevant and Appropriate Requirement
ASAOC	Administrative Settlement Agreement and Order on Consent
ATSDR	Agency for Toxic Substances and Disease Registry
BAAQMD	Bay Area Air Quality Management District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cis-1,2-DCE	cis-1,2-dichloroethene
COC	Chemical of Concern
DTSC	Department of Toxic Substances Control
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
FFS	Focused Feasibility Study
GC PID	Gas Chromatograph and Photoionization Detector
GWTS	Groundwater Treatment System
HVAC	Heating, Ventilation and Air Conditioning
Locus	Locus Technologies
MRL	Minimal Risk Levels
NPL	National Priorities List
O&M	Operations and Maintenance

OEHHA	Environmental Health Hazard Assessment
OOU	The Companies Offsite Operable Unit
PCE	tetrachloroethene
Philips	Philips Semiconductors Inc.
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RELs	Reference Exposure Levels
RL	Reporting Limit
RSE	Removal Site Evaluation
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SSDS	Sub-Slab Depressurization System
SMDS	Sub-Membrane Depressurization System
SVE	Soil Vapor Extraction
TCE	trichloroethene
The Companies	Advanced Micro Devices, Philips Semiconductors Inc., and TRW, Inc.
the Orders	Regional Water Quality Control Board Order Nos. 91-102, 91-103, and 91-104
trans-1,2-DCE	trans-1,2-dichloroethene
VI	Vapor Intrusion
VOCs	Volatile Organic Compounds

1. Introduction

This Indoor Air/Vapor Intrusion (VI) Removal Site Evaluation (RSE) and Removal Action Work Plan (Vapor Work Plan) was prepared by Locus Technologies in response to the Administrative Settlement Agreement and Order on Consent (ASAOC) for the former Signetics site (Signetics Site). The settlement was entered into voluntarily by Philips Semiconductors, Inc. (Philips) and the United States Environmental Protection Agency (EPA), with an effective date of 15 March 2019. The ASAOC scope of work requested and provided guidance for the Signetics Site Vapor Work Plan to detail procedures regarding VI evaluation of four commercial buildings and procedures for action, if necessary.

Locus is to work with the EPA and the respective owners and tenants to assess levels of tricholorethene (TCE) at occupiable spaces of the Signetics Site. Where necessary, and in cooperation with the EPA and the tenants, mitigation efforts shall be applied in order to reach acceptable levels of TCE in indoor air. Monitoring of the implemented efforts shall follow until mitigation efforts are no longer deemed necessary.

1.1 Purpose

The purpose of this Vapor Work Plan is to outline procedures to address groundwater-to-indoor air VI concerns within four commercial buildings within the Signetics Site. The work plan includes guidance on coordination with the EPA and building tenants, building surveying, sampling procedures, and reporting.

After data are collected and evaluated, an evaluation report of site conditions will be submitted to the EPA. Recommendations for additional phases of sampling will be considered, as needed.

1.2 Scope of Work

The activities to be completed under this Vapor Work Plan consist of the following tasks:

1. Pre-sampling tasks:
    - Collection of historical data and background information
    - Collection of information on chemical use and storage through building walkthroughs as necessary.
    - Preparation of building layouts, as necessary, and identification of the locations to be sampled at each VI evaluation study area.
    - Submittal to EPA of proposed sample location maps.
2. Collection of air samples in selected buildings, vent stacks, and outdoors.
3. Notification to EPA within 48 hours of receipt of results that exceed the short-term screening levels.
4. Preparation of a report to EPA within 30 days of completion of data review.
5. Discussion with EPA regarding the need for further VI investigations or mitigation activities of properties.
6. Technical support and input on EPA-lead community outreach materials

1.3 Work Plan Organization

This Vapor Work Plan describes the general approach for VI evaluations at the Signetics Site beginning with a discussion of the site background in Chapter 2. The Remedial Site Evaluation approach including building history, surveys, and sampling approach and the development of building-specific addenda is discussed in Chapter 3. The Sampling and Analysis Plan (SAP) is described in Chapter 4. The approach to evaluating the sampling results is in Chapter 5. The approach to reporting of the sample results is discussed in Chapter 6. Appendix A contains drawings from a 2018 VI Investigation at the Signetics Site. Appendix B contains the commercial building survey form, which will be used for all properties, as appropriate. Appendix C contains a Quality Assurance Project Plan (QAPP), which describes the data quality objectives (DQO) process used in the design of the evaluation study. Appendix D contains field instrument documentation.

1.4 Project Team Contact

The Project Team consists of the following main personnel:

Role	Name	Contact
Project Coordinator	J. Wesley Hawthorne	415-663-4702 hawthornej@locustec.com
Project Technical Lead	Africa Espina Guzun	(415) 799-9821 guzuna@locustec.com

Additional staff are available from Locus to assist with implementation of the work plan as needed.

1.5 Responsibilities of Project Personnel

The Project Coordinator will oversee the entire investigation and supervise inspection of building ventilation systems as well as the installation of ventilation improvements if necessary. The role also involve coordinating public communication activities for the project, including meetings with building owners, tenants, and agency representatives to facilitate the progress of ongoing investigation and mitigation activities.

The Project Technical Lead will coordinate collection of samples, arrange analytical laboratories to conduct sample analysis, perform QA/QC on field and laboratory data, and report on the investigation results. Additional staff members, including engineers and environmental technicians, will assist with sample collection as needed.

2. Site Description and Background

2.1 Site Background

The Signetics Site is located in Sunnyvale, California by North Fair Oaks Avenue and between the US 101 Highway and Central Expressway (Figure 1). The Signetics Site is comprised of four properties—two former semiconductor fabrication and testing facilities located at 811 East Arques Avenue (811 Arques) and 440 North Wolfe Road (440 Wolfe), and two office buildings located at 815 and 830 Stewart Drive (Figure 2). Signetics, now Philips Semiconductors, Inc. (Philips), owned and operated a semiconductor manufacturing facility at the site from 1964 - 2005. In 2005, demolition of the Philips-owned building at 811 Arques and redevelopment activities occurred. All properties are no longer owned or operated by Philips.

The Signetics Site is part of the Triple Site which also consists of the Advanced Micro Devices (AMD) site located at 901/902 Thompson Place and the TRW Microwave site (TRW) located at 825 Stewart Drive. The Triple Site also includes the Offsite Operable Unit (OOU), a co-mingled plume composed of volatile organic compounds (VOCs) downgradient and north of the AMD, TRW, and Signetics Sites. The OOU is defined as the area inside a five micrograms per liter (μg/ L) contour for TCE in shallow-zone groundwater (Figure 3).

Groundwater beneath the Signetics Site is impacted by VOCs. An extensive groundwater extraction, treatment, and monitoring program has been in operation since 1982 to monitor and control the migration of VOCs in the groundwater beneath the site (Locus, 2001). The VI study area for the Signetics Site is defined as the boundary for the four included properties (Figure 2). Various investigation methods will be used, as appropriate, to evaluate VI within this area.

2.2 Regulatory Background

The Signetics Site was proposed for inclusion on the National Priorities List (NPL) on 15 October 1984 by the EPA. However, this proposal was rescinded on 4 October 1990, because the site was regulated as a Resource Conservation and Recovery Act (RCRA) site. Commencing in 1985, the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB), was the lead agency for overseeing cleanup activities. The site was subject to RWQCB Order 91-104 (the Order), adopted on 19 June 1991, which included soil and groundwater clean-up measures. On 7 August 2014, the lead agency role of the Triple Site was transferred from RWQCB to EPA Region 9. On 18 February 2015, EPA Region 9 issued an Action Memorandum requesting time-critical Removal Action at the Triple Site to address the VI pathway.

On 12 March 2019, an ASAOC was executed (effective date 15 March 2019) which includes a Focused Feasibility Study (FFS), Removal Site Evaluation (RSE), and any necessary removal action. This Vapor Work Plan is being submitted in accordance with the ASAOC.

2.3 Regional Geology

The Signetics Site is located in a structural depression between the Santa Cruz Mountains to the south and the Diablo Range to the north, on terrain that gently slopes to the north-northeast. The area is underlain by a sequence of Plio-Pleistocene and Upper Quaternary unconsolidated sediments up to 1,500 feet (ft) thick (Iwamura, 1980).

The sediments underlying the site were shed from the Santa Cruz Mountains and deposited in alluvial, estuarine, and sublittoral environments. Deposition of sediments was largely controlled by variations in sea level during successive ice ages. In times of low sea level, the study area would have collected coarser-grained alluvial deposits. The depositional environment during these periods likely included meandering stream systems and the outer portions of alluvial fans. In times of high sea level, the depositional environment was similar to the present-day San Francisco Bay. Located in a sheltered bay, the low-energy water allowed the settling of finer-grained material out of suspension.

The change of depositional environments probably occurred gradually enough that significant intergrading of coarse-grained sediments by fine-grained sediments occurred during encroaching shoreline episodes. Conversely, significant erosion of unconsolidated fine-grained sediments likely occurred during receding shoreline episodes. This depositional history resulted in a complex sedimentary sequence.

2.4 Site Hydrogeology

The aquifer system at the site has been described in detail in the Remedial Investigation Report [Harding Lawson Associates (HLA) et al., 1991]. The subsurface has been divided into the "A" and "B" aquifer zones. The "B" aquifer zone has been further divided into the "B1", "B2", "B3", and "B4" aquifers. The aquifers occur at the approximate depths listed in the table below.

Aquifer	Depth in Feet Below Ground Surface (bgs)
A	0 - 30
B1	30 - 50
B2	50 - 70
B3	70 - 90
B4	90 - 110

(Einarson, Fowler & Watson, 1999)

Previous investigations at the site have revealed that the aquifers at the site have varying thicknesses and are frequently discontinuous. At some locations, more than one water-bearing unit may be present within an aquifer. There are also localized areas where aquifers coalesce. This is particularly the case between the "B2" and "B3" aquifers. The "A" and "B4" aquifers are generally more laterally continuous at the site than the other aquifers (EMCON, 1996). A detailed small-scale description of the stratigraphy and several cross-sections were presented in the first Five-Year Status Report and Remedial Effectiveness Evaluation for the site (DM, 1996).

Regional groundwater flow in the "A" and "B" aquifers is generally northward at the site. However, operating extraction wells, trenches, and sumps cause the local groundwater flow direction to differ from the regional groundwater flow in the vicinity of the site.

2.5 Nature and Extent of Chemicals at the Site

The soil and groundwater impacts at the site have been described in previous reports for the Signetics site. This section summarizes the results of these previous findings.

Signetics began operations of a semiconductor manufacturing facility at the site in 1964. Various organic solvents were used in the manufacturing processes at the site. In 1982, a source area for the site was identified as a leak in an underground waste solvent storage tank west of the building at 811 East Arques Avenue. After this source was identified, a review of potential source areas at the site was completed. As a result of this investigation, a second source area was identified near wastewater neutralization tanks on the north side of the 811 Arques building. The tanks were removed in 1982. Impacted soils were excavated in 1982 and 1987.

Groundwater extraction and treatment in the A-aquifer began in 1982. Groundwater treatment system (GWTS) has expanded throughout the years to include A-aquifer extraction trenches, dual-phase groundwater/soil gas extraction wells and B1 aquifer extraction wells.

A pilot soil vapor extraction (SVE) system was installed in 1988 near the north side of the 811 Arques building. The SVE system was expanded in 1990 and 1992. The SVE system ceased operation in 1996, with the approval of the RWQCB, after testing revealed continued operation would not provide additional significant contamination removal.

Eight chemicals of concern for the site were established in the 1991 Order: 1,1-dichloroethane (1,1-DCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (cis-1,2-DCE); trans-1,2-dichloroethene (trans-1,2-DCE); Freon 113; 1,1,1-trichloroethane (1,1,1-TCA); trichloroethene (TCE); and vinyl chloride. In February 2020, EPA requested the chemicals of concern be consistent with the *Action Memorandum for the Triple Site* (EPA, 2005). Thus, chloroform and tetrachloroethene (PCE) were added to the chemicals of concern list. TCE is the chemical most commonly present at the Signetics site and at the neighboring operable units, and therefore serves as the indicator chemical for the site.

In 2005, a groundwater trench was constructed at 440 Wolfe as part of redevelopment. Additional soil excavation also occurred at that time. The original GWTS operated until July 2007, when it was removed to accommodate property redevelopment. A new GWTS was installed between 440 Wolfe and 815 Stewart and assigned the address 813 Stewart Drive. The new GWTS began operating in October 2008. According to the Five-Year Status Report and Remedial Effectiveness Evaluation 2011 to 2015, the groundwater extraction and treatment activities have removed over 42,600 pounds of VOC chemicals from the Signetics Site as of December 2015 (Locus, 2016).

Chemicals have been detected in the upper four aquifers at the site. Groundwater monitoring is conducted in these aquifers as well as the "B4" aquifer to verify the vertical containment of the plume. The chemicals have not impacted the deeper aquifers that are used for public water supply (RWQCB, 1996).

2.6 Previous Vapor Intrusion Investigations

Vapor intrusion investigations in the Signetics Site began in 2002, under direction from RWQCB. In October 2002, investigations at 440 Wolfe and the former building at 811 Arques (which was later demolished in 2005) were completed. Further VI investigations were conducted at the Signetics Site in 2018. Potential investigation and mitigation options were discussed with three property owners at the Signetics site. Two building owners (440 Wolfe and 815 Stewart) agreed to establish access agreements and initiate activities to address potential VI. A third building owner, at 830 Stewart, declined to proceed. Activities completed at 811 Arques, 440 Wolfe, and 815 Stewart are described below. Summaries of previous investigations are being provided as supporting information and will be amended based on future building surveys and documented in Building-Specific Work Plan Addenda.

2.6.1 811 East Arques Avenue

Vapor intrusion investigations using Summa-passivated canisters and flux chambers were conducted at this property in 2002 (Locus, 2003). These investigations were done for the former manufacturing facility located at 811 East Arques Avenue which was demolished in 2005, not to be confused with the commercial hardware store currently on the property, which also has the address of 811 East Arques Avenue.

Flux chamber evaluation was selected for the 2002 investigations to quantify the potential contribution to indoor concentrations from VI, which could not be evaluated using only indoor ambient samples due to the historical use of VOCs in the building. Flux chamber samples were collected in the north basement of the 811 Arques building and outside because it overlays the highest shallow groundwater concentrations and thus the most likely location to have indoor flux. However, there was no indication that volatilization occurred directly through the uncracked building slab. TCE indoor flux was detected over the seam and cracks in the slab at up to 0.031 µg/ft/min (micrograms per minute per foot of seam or crack). The maximum indoor air results for TCE was 16 µg/m^3 in the basement of the former 811 Arques building. However, as a building where TCE was used for industrial operations, these indoor air concentrations were not attributed solely to VI. Using this flux result along with measured building parameters, the indoor air concentration estimated to be caused by VI was 0.16 µg/m^3. The evaluation of the VI pathway using the flux chambers demonstrated that indoor inhalation exposure through that pathway was within acceptable limits and not expected to cause unacceptable risks or hazards. Because other sources were present and contributing to indoor air concentrations, it was recommended that sump covers be sealed to minimize any potential contribution from VI (Locus, 2003). In May 2005, the facility building at 811 Arques was demolished (Locus, 2006) as part of redevelopment efforts.

2.6.2 440 North Wolfe Road

440 Wolfe is a 3-story tall commercial building with a sub-grade slab basement that is approximately 24,000 square feet (sq ft). A building layout for the basement can be seen in Appendix A. The building is open 7 days a week as office space and its occupants normally complete 8-hour work shifts. There are occupied offices on all floors except the basement. The basement is used for storage; mechanical equipment including the heating, ventilation and air

conditioning (HVAC) system, and also contains an enclosed server room as well as restrooms. Groundwater wells near the building showed TCE concentrations up to 64 µg/L in 2018.

VI investigations for this building were conducted in 2002 using Summa-passivated canisters. TCE was detected at one location in the basement of 440 Wolfe at 9.3 $\mu g/m^3$, in the server room located in the center of the basement. All other locations sampled in the 440 Wolfe basement during this sampling event were below 0.75 $\mu g/m^3$. As a building where TCE was used for industrial operations, these indoor air concentrations were not attributed solely to VI. The flux measurements collected at the 811 Arques building with this investigation demonstrated that indoor inhalation exposure through that pathway was within acceptable limits and not expected to cause unacceptable risks or hazards (Locus, 2003).

In May 2018, a building walkthrough was conducted with the property manager and facilities manager to complete a preliminary building survey and explore potential mitigation options. Preemptive mitigation options were also discussed with the property manager, and they expressed an interest in proceeding with preemptive mitigation. Considering the available data from this property, it was concluded that preemptive mitigation would be appropriate.

The 440 Wolfe basement had visible cracks along the sub-grade slab, which is exposed throughout most of the basement. Some cracks were observed to be 10 ft in length, and had visible gaps of approximately 1 mm. Some of the cracks appear to have been repaired over the years, however the sealant was deteriorating. Floor drains and sumps were also observed however they contained one-way valves to prevent VI. The basement has open louvres to the outside air on the north and east walls and is naturally well-ventilated. The server room is located in the center of the basement and has self-contained ventilation due to the sensitivity of the equipment.

The mitigation options considered at 440 Wolfe were basement crack sealing and indoor air purification. Due to the proximity of the basement to groundwater, a sub-slab depressurization system (SSDS) was not feasible. Basement crack sealing was performed in June and July 2018 by applying self-leveling concrete sealant to all visible cracks along the sub-slab by Fred Ellrott, a licensed professional.

The first post-mitigation indoor air sampling event was conducted on 14-15 August 2018, approximately two weeks after the crack sealing was completed at the locations shown in Appendix A. All samples were below short-term action levels in the basement and the first floor office as shown in Table 1. The highest observed TCE concentration was located in the server room (5.7 $\mu g/m^3$). This is below the short-term 8-hr commercial action level of 9.0 $\mu g/m^3$ but above the site-specific action level of 5.0 $\mu g/m^3$ as specified in the ASAOC. The server room did not require immediate or prompt mitigation, however additional preemptive mitigation was considered appropriate.

Therma LLC, an expert HVAC contractor, inspected the existing server room ventilation system and provided a preliminary recommendation to increase air exchanges. Based on discussions with the HVAC contractor, to sufficiently increase the air exchange while maintaining the necessary temperature control for the server room, significant HVAC upgrades and additional maintenance efforts would be needed. Because the server room is less than 2,000 square feet, it was determined that a stand-alone vapor phase carbon treatment system would be an effective method for indoor air mitigation. A Carbtrol air purification system consisting of carbon drum and blower was installed on 30 November 2018. A sketch of the system is included in Appendix A. Quarterly inspections of the system and post-mitigation sampling have been initiated to ensure mitigation is effective. Placard details and examples will be provided in the Building Specific Work Plan Addenda for EPA review. Building specific mitigation system details such as carbon filter flow rate and change out rate will be provided in the Building Specific Work Plan Addenda for EPA review.

Post-mitigation sampling and the first quarterly operations and maintenance (O&M) inspection of the carbon drum took place 22 January 2019. TCE concentrations were below immediate and short-term commercial action levels at all locations. All locations were also below the TCE site-specific action level. The server room had a concentration of 3.6 $\mu g/m^3$, a reduction over initial concentrations. The carbon drum was in good operating condition.

A third post-mitigation sampling event took place on 18 February 2019. Results continued to be below commercial action levels and the site-specific action level at all locations. Future mitigation system maintenance will be included in the Building Specific Mitigation Completion Reports. Updated information will be confirmed and updated, as necessary, during the comprehensive building survey and documented in the Building Specific Work Plan Addenda.

2.6.3 815 Stewart Drive

815 Stewart is a commercial slab on-grade building with approximately 30,500 sq ft. A building layout can be seen in Appendix A. The building is operated as a fitness facility which is open 7 days/week. Offices are located on the south side of the building. Building occupants either attend for short periods of time or complete 8-hour work shifts. Indoor air samples had not been previously collected in this building. Groundwater wells near the building showed TCE concentrations up to 150 µg/L in 2018.

In May 2018, a building walk-through with the property owner was conducted to complete a preliminary building survey and consider potential mitigation options. The building foundation was constructed in three phases, the original buildings and two subsequent additions, resulting in three separate foundation structures within the building.

The 815 Stewart foundation appears in good condition with no visible cracks. Utility piping conduits and drains are limited to the locker rooms. The majority of the building is an open area with large windows and roll-up doors and is naturally well ventilated. According to staff, the windows are generally kept open during summer months, and closed during winter months. Mechanical ventilation systems include ventilation ducts and exhaust fans with a conventional gas furnace for one studio area. The use of space heaters is limited to the office areas and the front desk in the southern portion of the building.

Preemptive mitigation options were also discussed with the property owner, and they expressed an interest in proceeding with preemptive mitigation. Considering the available data from this property, it was concluded that preemptive mitigation would be appropriate. SSDS was selected as an appropriate mitigation option for this building, based on its effectiveness at other similar structures at the Triple Site. Because the building had additions and changes to the foundation, multiple suction points and vent stacks were needed to adequately address the entire building footprint. In addition, the owner requested that the system be installed behind the climbing structures to avoid interfering with the building use. The system was completed in September 2018 and can be seen in Appendix A. The final SSDS includes eight suction points and five vent stacks with fans.

The first post-mitigation indoor air sampling event was conducted on 17-18 September 2018, approximately two weeks after the SSDS was completed at the locations shown in Appendix A. All samples were below commercial short-term action and site-specific action levels as shown in Table 2. The second post-mitigation indoor air sampling event was conducted on 25-26 October 2018. Again, all samples were below commercial short-term action and site-specific action levels. The first quarterly O&M inspection of the SSDS took place 27 November 2018. The SSDS was in good operating condition.

The third post-mitigation indoor air sampling event was conducted on 22-23 January 2019. All samples remain below commercial short-term action levels. The outdoor sample TCE concentration measured during the January sampling event was 3.6 µg/m^3, and the indoor samples results had similar concentrations. These concentrations remained lower than the site-specific action level. However, in the light of the elevated results when compared with earlier event results, confirmation sampling was conducted on 18-19 February 2019. Results from the February 2019 sampling were not above commercial action or site-specific levels in any samples, and the outdoor sampling results were more consistent with previous sampling events at the Triple Site. The second quarterly O&M inspection of the SSDS took place 26 February 2019. The SSDS was in good operating condition.

2.6.4 830 Stewart Drive

Communications with a representative at 830 Stewart were attempted over the years for various reasons, primarily associated with access to the groundwater monitoring wells installed on the property. The most recent communication attempts were made in February 2019 with the purpose of establishing an access agreement and discussing vapor intrusion concerns. Attempts have ultimately not been productive and have not resulted in any environmental work on the property.

3. Building Surveys and Work Plan Addenda Development

The Vapor Work Plan RSE begins with a review of historical background and collection of available building information to assist in the implementation of building surveys. The building surveys will in turn assist in the development of Building-Specific Work Plan Addenda.

3.1 Historical Background

Historical background information of the Signetics Site will be reviewed prior to conducting building surveys, as it relates to the RSE. General site history, regional geology and hydrogeology, and the nature and extent of chemicals used at the site shall be included in this review. Section 2 of this Vapor Work Plan includes a summary of historical background information, however additional information may be reviewed before the implementation of building surveys.

3.2 Building-Specific Information

Before building surveys are conducted, available and pertinent information for each building at the Signetics Site will be collected and reviewed. This information may include previous drawings, surveys, and sampling data collected at or near buildings. The types of sampling data that may be reviewed include groundwater, soil, soil vapor, sub-slab soil vapor, indoor air, pathway air, and outdoor air. If mitigation systems had been previously installed, that information will also be reviewed.

Building-specific information available to date for 440 Wolfe and 815 Stewart is included in Section 2.6 of this Vapor Work Plan.

3.3 Building Survey

After historical background and building-specific information is reviewed, building surveys will be conducted using the form in Appendix B. A knowledgeable contact for each building or residence will be consulted for completion of the checklist. This checklist is designed to evaluate characteristics of the building use and ventilation systems that may impact indoor air quality. Any identified current or recent chemical usage that may impact VOC concentrations in the air will be noted on these forms. The completed forms will be stored in a web-based database that contains an inventory of documented sampling and related activities for all of the project sites. Real-time access to the database will be given to EPA for oversight. Detailed components of the survey form include:

- General Information
  - Building Use / Business Type
  - Occupancy Information
  - Building Characteristics
  - Foundation Type and Condition
  - Basement Use and Plumbing
- Indoor Air Quality and Sampling Factors
  - Recent and Current Activities
  - Observations of Features that May Influence VI
  - Building Construction
  - Pathway Analysis
  - Potential Sampling Locations
- Potential Indoor Chemical Sources Inventory
- Building HVAC System Information

- System Type
- System Operations
- Issues Impacting VI Potential
- Outdoor Air Intake Information
- Ventilation Zones and Settings

3.4 Building Survey Implementation

Access agreements shall be established with each property owner in order to conduct the building surveys. Access agreements shall provide access to Philips contractors, the EPA, and EPA contractors. Access agreements are already in place for 440 Wolfe, 815 Stewart, and 811 Arques, and unsuccessful efforts were made to also obtain an access agreement for 830 Stewart. Property owners and tenants, if applicable, will also be notified of the building survey scope and proposed timeline.

Per the ASAOC schedule, building surveys will be conducted within 21 days upon EPA approval of this Vapor Work Plan, assuming access has been granted by the building property owners and tenants.

3.5 Building-Specific Work Plan Addenda Development

After building surveys are conducted, Building-Specific Work Plan Addenda will be developed for each building where surveys were completed. Each building-specific work plan addenda shall include documentation or reference of the pertinent historical and building-specific information reviewed (which include letters and reports provided to building owners and on-site facilities managers), building survey results, a ventilation assessment, a building-specific conceptual site wide model, and an evaluation of data gaps. The Building-Specific Work Plan Addenda shall also include a proposed sampling plan and short-term and long-term action levels and time frames. The sampling plans shall be based on the generic SAP discussed in Section 4, and adjusted to each building using the survey results. Action levels and times frames are discussed in Section 5.

Descriptions and evaluation of chemical manufacturing or usage activities that take place within buildings should be considered during the Building-Specific Work Plan Addenda development, if applicable. Potential indoor sources should be managed or sampling strategies adjusted if products containing site COCs (chemicals of concern) are identified during the building survey such as paints, glues, or other VOC containing products. To the extent feasible, potential sources of COCs shall be removed or contained. Indoor sampling locations shall be placed away from these manufacturing or usage areas to avoid sample interference. Further details are explained in Section 4 sample conditions.

The Building-Specific Work Plan Addenda will be submitted to the EPA for approval before the commencement of indoor air sampling activities.

4. Sampling and Analysis Plan

This chapter discusses the methods and reporting procedures to be used for air or soil gas sampling in this investigation. Results will be used to assess potential groundwater-to-indoor air VI and potential impacts to outdoor air.

4.1 Site Specific Sample Strategy for Vapor Intrusion Evaluation

Building-specific work plans addressing specific properties on this site shall be prepared before vapor intrusion air sampling is conducted. The general approach to the investigations for all properties is described below.

4.1.1 Indoor Air Samples

Indoor air sample locations will be selected in areas that are most representative of building occupancy, as well as other areas with characteristics that might facilitate VI. For example, sampling locations with separate HVAC systems within the same building will be selected. If possible, two sets of indoor air samples will be collected per building, one with the HVAC system on and one with the HVAC system off.

The indoor air sampling will be representative of inhalation exposure point concentrations for the occupants of the buildings. Indoor air samples will be collected at the breathing zone elevation of building occupants, and will be documented for each sample. Building-Specific Work Plan Addenda shall state the location of each sample and selected sampling heights above floor level.

4.1.2 Pathway Samples

Pathway samples will be selected for areas which are accessible but not routinely occupied for extended periods (e.g. electrical closets, janitor's closets). Where identified as a potential source to the routinely occupied areas of the building, these areas will be sampled to evaluate whether preferential pathways exist by way of floor drains, sinks, other plumbing fixtures, and/or floor cracks. This information could be used in consideration of mitigation options for the building, should they be necessary.

Some buildings may have crawlspaces or subfloor areas that are generally not accessed by occupants. However, sampling results from those areas may be used to distinguish between chemical concentrations originating through VI and chemicals originating from other sources. Where possible, samples will be collected from these areas for evaluation of potential pathways for VI. Building-Specific Work Plan Addenda shall state if pathway samples are necessary and where they will be located.

4.1.3 Onsite Outdoor Air Samples

Representative onsite outdoor samples will be collected to compare indoor and outdoor air concentrations. The outdoor air samples provide data to quantify contributions from outdoor sources. It is expected that the outdoor air concentrations can be adequately represented using a few outdoor air samples, distributed throughout the properties near buildings where indoor air is being sampled. At least one outdoor sample will be taken per day per building. If accessible, outdoor samples may also be collected at the HVAC system intakes to directly monitor outdoor concentrations that would be entering the building. Building-Specific Work Plan Addenda shall show where outdoor samples will be placed for comparison with indoor samples.

4.1.4 Sub-Slab Soil Gas Samples

Sub-slab soil gas samples, if necessary, will be selected in occupied areas which are not accessible or where indoor air sampling is not practical. Depending on building use and operations, indoor air sampling may be impractical in distinguishing between chemical concentrations originating through VI and chemicals originating from other above-ground sources. Removal of these potential above-ground sources that would interfere with sampling may not be feasible.

The sub-slab soil gas samples provide data as another line of evidence to support the potential of VI as a pathway. Building-Specific Work Plan Addenda shall state if sub-slab soil gas samples are necessary, where sampling ports will be located, and depth of the sampling ports to be installed.

4.2 Site Specific Sample Strategy for Outdoor Air Evaluation

To evaluate potential VI mitigation system impacts to outdoor air, air samples will be collected from offsite locations and the mitigation system vent stacks. ~~-~~The results of these samples will be used to assess the impact of the vent stack discharges from sub-slab depressurization systems (SSDS) and sub-membrane depressurization systems (SMDS) ~~mitigation systems~~ on outdoor air ~~and to evaluate the applicability of~~by determining if ~~-~~San Francisco Bay Area Air Quality Management District (BAAQMD) regulations, considered Applicable or Relevant and Appropriate Requirements (ARARs), ~~to vent stack discharges from sub-slab depressurization systems (SSDS) and sub-membrane depressurization systems (SMDS)~~are being substantively met.

A list of outdoor air sampling locations and a figure will be provided to the EPA at least 21 days prior to conducting the field work. A daily schedule indicating locations to be sampled will also be provided to the EPA after access is coordinated with the property owner.

The Outdoor Air Evaluation will include sampling offsite outdoor air, onsite outdoor air, and mitigation system vent stacks. In addition, the samples shall be collected within a 2-week period, dependent on tenant and owner cooperation and availability. The availability of sampling equipment, specifically a sufficient quantity of Summa canisters and passive samplers, may also impact the scheduling of this event.

4.2.1 Offsite Outdoor Air Samples

Offsite outdoor air samples will be collected from locations in Sunnyvale. The results from these offsite samples will be compared to onsite outdoor sample results (see Section 4.1.3) to determine if there is a statistically significant difference in air concentrations. EIM, ProUCL, or similar statistical tool may be used to apply a statistical analysis comparison that is appropriate to sample size (e.g. ANOVA or Wilcoxon Rank Sum). Proposed locations for these offsite sample locations may include the following (pending access arrangements with Cities of Sunnyvale and Santa Clara) (Figure 4):

- Fair Oaks Park (0.2 miles west-northwest of the Site)
- Swegles Park (0.4 miles east-northeast of the Site)
- Ponderosa Park (approximately 1.5 miles south of the Site)
- Braly Park (approximately 1.4 miles south-southwest of the site
- Martin Murphy Park (approximately 0.8 miles west of the Site)
- Columbia Park (approximately 0.9 miles northwest of the Site)
- Seven Seas Park (approximately 1.1 miles north-northwest of the Site)
- Lakewood Park (approximately 1.1 miles north-northeast of the Site)
- Bracher Park (approximately 2.2 miles east-southeast of the Site)
- Fairwood Park (approximately 1.5 miles northeast of the Site)

These offsite outdoor sample locations are shown on Figure 4 and sampling information is tabulated in Table 3. Other locations may also be added based on accessibility and lack of other nearby COC sources. Offsite sample locations may not necessarily be sampled concurrently with indoor air sampling. Instead, samples will be collected from onsite and offsite outdoor air sample locations on the same date for at least two sampling events. To evaluate the maximum potential contribution from onsite sources to outdoor air, sampling dates will be selected based on weather forecasts when wind speed is expected to be minimal (see Section 4.4). Sampling will also be conducted when the groundwater treatment system and installed VI mitigation systems are operating normally.

4.2.2 *Mitigation System Vent Stack Samples*

Vent stack samples and additional discharge data (e.g. flow rate) will be collected to determine vent stack emission rates and concentrations in accordance with potentially applicable BAAQMD regulations. These sample results will also be used to inform interpretation of onsite and offsite outdoor air sample results.

Vent stack samples will be collected following SSDS and SMDS mitigation system installation. Vent stack sample locations will be building-specific and vary depending on the type of system, building characteristics, and accessibility to the vent stack. Sample locations and frequency shall be specified ~~in building specific addenda~~prior to sampling if mitigation systems currently exist (see Section ~~3~~4.2) or in the building-specific mitigation completion reports for new systems (see Section 6.2.2).- Additionally, if feasible, vent stack samples will be collected on the same day as offsite air samples discussed in Section 4.2.1.

After results are received from the sampling event(s), vent stack emission rates and concentrations will be compared to BAAQMD regulations, including, but not limited to, BAAQMD Rules 8-47-109 and 8-47-113, and Regulation 2, Rule 5, Table 2-5-1, acute and chronic inhalation reference exposure levels (RELs). These data will ultimately aid in the determination of applicability to BAAQMD requirements and next steps, such as exemption petitioning, permitting, emissions treatment, risk assessment, and/or additional monitoring. In particular, BAAQMD Regulations 2 and 8 (and references therein) will be consulted and implemented, as applicable. Air emissions from the GWTS air stripper, which are currently monitored and covered under an existing BAAQMD Permit to Operate, will also be included if/as required for the determination of applicability of vent stack discharges under BAAQMD. GWTS air stripper discharge is calculated in accordance with the BAAQMD Permit to Operate. Additionally, as applicable under BAAQMD and the EPA, vent stack discharges may be evaluated in conjunction with a similar investigation at the adjacent OOU site.

4.3 Sampling Equipment

Indoor and outdoor air sampling will be conducted using two methods, depending on the duration of the sampling (refer to Section 4.5 and site-specific work plans regarding sampling duration). Radiello radial passive samplers for VOC sampling (RAD145) will be used for sampling periods of 24 hours (or longer). For sampling periods of less than 24 hours the minimum reporting limits for passive samplers are above the current EPA long-term screening levels. Therefore, for sampling events less than 24 hours in duration, six-liter Summa-passivated canisters must be used. It is anticipated that 24-hour sampling will be acceptable in most cases.

4.3.1 Soil Gas Sample Wells

Soil gas sampling will be conducted in accordance with applicable guidance (CalEPA, 2015). The soil gas samples will be collected using a dual-casing direct push sampling system and Post Run

Tubing (PRT) System. The direct push machine will drive probe rods equipped with a PRT point and holder to the correct sample depth. The probe rod will be sealed at the surface with granular and hydrated bentonite at appropriate depths. Installation will include regularly checking and cleaning the PRT point holder threads and its adaptor. The PRT adaptor will be connected to stiff ¼-inch tubing (e.g. Nylaflow, PEEK, or Teflon), which will ensure that sufficient torque is available to screw the adaptor tightly to the PRT point holder. Tubing will link the rig to a six-liter passivated steel Summa canisters at the time of collection. Leak and shut-in tests will be performed prior to collecting soil gas samples. In addition, an equipment blank will be sampled from an assembled soil gas probe with tip and tubing prior to soil gas sampling.

If direct push sampling system installation through a building's foundation slab is impractical due to physical obstacles or constraints imposed by property managers, or owners, temporary soil gas wells may be constructed by hand-auger and the use of Vapor Pins™ as consistent with methods and procedures provided in the Advisory (CalEPA, 2015).

If further sampling from that location is not anticipated, soil gas wells will be decommissioned following the completion of sampling and in accordance with Section 3.4 of the Advisory. Soil gas wells may also be left intact with the property owner's permission to allow subsequent sampling over an extended time period.

4.3.2 Passive Samplers

Twenty-four hour indoor and outdoor air samples will be collected using Radiello passive samplers (refer to Section 4.3). Radiello passive samplers rely on the diffusion of analytes through a diffusive surface onto an adsorbent. The analytical laboratory will provide the Radiello samplers, which each consist of a supporting plate with clip, a cartridge, and a diffusive body. Before use, the supporting plate and clip will be assembled for suspending the sampler. The cartridge will be delivered in a tube in a sealed plastic bag to prevent contamination during transit. At the time sampling is to begin, the cartridge will be transferred from the tube in the plastic bag into the diffusive body without touching the cartridge. The cartridge will be seated securely in the diffusive body, correctly centered, and not sticking out from the diffusive body by even half a millimeter. The diffusive body will then be seated on the supporting plate while being kept vertical; keeping the diffusive body vertical will prevent the cartridge from becoming unseated. Care will be taken not to bend the diffusive body nor touch the cartridge during assembly. At the conclusion of sampling, samplers will be replaced into their tubes and original packaging for shipment back to the laboratory. After sampling, the analytes are thermally desorbed and analyzed by USEPA Method TO-17.

4.3.3 Summa Canisters

If necessary, indoor and outdoor air samples will be collected in six-liter passivated steel Summa canisters (refer to Section 4.3). ~~One~~Six-liter Summa canisters will also be used for collection of vent stack samples with 10% replicate samples for QC purposes. The indoor and outdoor air samples will be time-integrated over the normal operating hours for the building using a flow controller. For time-integrated air samples, a sample of air is drawn through a sampling train of components that regulate the rate and duration of sampling into a pre-evacuated, specially prepared passivated canister. Flow controllers set at approximately 150 ml/L will also be used for vent stack sampling to control flow into the canister and thereby enabling the collection a representative sample. The analytical laboratory will provide pre-evacuated, individually-certified Summa canisters. The canisters are stainless steel containers that are supplied under negative pressure. Once received from the laboratory, a pre-evacuated Summa canister can hold a high vacuum (i.e., >30 inches of mercury (" Hg)) for up to 30 days. It should be used during this period to ensure appropriate vacuum during sampling.

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Each pre-evacuated canister received from the laboratory is to be equipped with a brass plug, vacuum gauge, flow controller, and particulate filter. The brass plug ensures that there is no loss of vacuum due to a valve accidentally opening during shipment. The plug also prevents dust from contacting the valve. A vacuum gauge will be used to measure the initial and final vacuum of the canister and to monitor the canister when collecting an integrated sample. A flow controller (critical orifice) is used when taking an integrated sample over time. Various orifices are available. A fixed-rate flow controller will be used. A particulate filter will also be used with the flow controller to prevent particulates from entering the orifice. Prior to shipment, the laboratory is to confirm the flow rates for each orifice. It is imperative that orifices are certified "clean" prior to use; therefore, orifices should not be re-used in the field.

When the canisters are requested from the laboratory, the sampling duration will be specified so that the laboratory can pre-set the flow controller rates. The flow rate is to be set at the laboratory using a pressure of 30" Hg to ambient air. If the source of the air sample is at a pressure other than ambient pressure, the canisters will fill faster or slower depending on the sample pressure. By providing the appropriate pressure to the laboratory, the laboratory can simulate the proper pressure and set flow controllers accordingly. For a six-liter canister, a fixed-flow controller is set to collect 5 liters (L) of sample over the time interval so that a net negative pressure is maintained in the canister. ~~Similarly, the flow controllers for a one-liter canister are set to collect 800 ml of sample over the designated time period.~~ The appropriate flow rate will be set by the laboratory based on the duration of the sampling event (refer to site-specific work plans). For example, the flow rate for a 6-L canister collecting a 12-hour composite sample would be approximately 6.9 milliliters per minute. For an 8-hour composite, the sample collection rate would be approximately 10.4 milliliters per minute.

After sample collection is completed, the canisters are sent to the laboratory, where they are analyzed according to USEPA Method TO-15 in Selective Ion Mode (SIM) for six-liter canisters. ~~and USEPA Method TO-15 low level for one-liter canisters.~~

4.3.4 *Vent Stack Sample and Measurement Ports*

Sample ports will be installed for each vent stack per EPA Method 1A. Sample ports will be located on straight runs at least 10 pipe diameters upstream and eight pipe diameters downstream of any area of flow disturbance, such as bends, outlets, inlets, and blowers. Velocity, temperature, and moisture (relative humidity) will also be measured at each vent stack for eventual use in discharge calculations. Measurement ports will be located at least eight pipe diameters downstream from the sample ports. If the configuration of the vent stack does not allow for sample and velocity ports to be located using the aforementioned specifications, alternative locations will be used per EPA Method 1A. Sample and measurement ports will be one-half inch in diameter. Ideally, stack sample ports will be accessible at ground level.

4.3.5 *Portable Gas Chromatograph and Photoionization Detector*

Results from a portable gas chromatograph and photoionization detector (GC PID) will be used for vent stack sampling to determine if a correlation can be made between the TCE analytical results from other methods and the TCE data collected by the GC PID. If there is a correlation, discussions would be held with the EPA to determine if future sampling can be performed using only the GC PID. Stack gas TCE concentrations will be monitored/screened, near real time, using a calibrated GC PID such as the Defiant Technologies Frog 5000 (FROG) or equivalent (see Appendix D for documentation). The GC PID will be calibrated by the vendor using a certified TCE standard immediately prior to deployment and will have a minimum TCE detection limit of 1.0 ppbv or 5.37 μg/m^3 at standard temperature.

4.4 Sampling Conditions

Based on the EPA finding that TCE indoor air concentrations from VI in the San Francisco Bay Area are up to two-to-three times higher during the colder months, weather forecasts will be reviewed to determine when the daily low temperature falls below 50° F. This temperature was selected as a reasonable determination of colder weather without being overly restrictive on the sampling schedule. Wherever practicable, indoor air sampling will be planned for dates when the forecast meets that criterion. This is generally expected to occur between December and February. The weather forecast from the National Weather Service will be used to schedule the air sampling during these conditions. This forecast can be obtained from: http://forecast.weather.gov/MapClick.php?lat=37.3688&lon=-122.03634. It is recommended that indoor temperatures be about 10° F above outdoor temperatures during sampling events. This recommendation is not a requirement for sampling but is expected to be met given that indoor air thermostats are likely to be set to 65° F or above.

Indoor air sampling events will be completed in two rounds, one to be representative of normal occupied conditions, and another sampling event to represent reasonable maximum VI conditions. Samples representative of normal occupied conditions includes the operational HVAC systems, if applicable, and sampling times representative of actual exposure conditions (e.g. 8 or 12 hours, refer to site-specific work plans). Samples representative of reasonable maximum VI conditions entails turning off HVAC systems (where feasible) and sampling for a longer duration (24 hours) per EPA guidelines. Samples collected for a duration of 24 hours or more will be sampled using sorbent passive samplers. Samples collected for durations shorter than 24 hours will be collected using Summa canisters in order to achieve reporting limits low enough for comparison to screening levels; at durations less than 24 hours, reporting limits of passive samplers are too high. Note that although there are differences in sampling time, conditions, and devices between the HVAC on/off samples, it is not the intent for the two samples to be comparable for statistical purposes. Rather, each type of sample represents different exposure conditions (actual versus reasonable maximum). Additional details regarding sampling conditions follow.

The initial sampling will be implemented with active HVAC systems, if applicable for the building. Samples will be collected with the HVAC systems in normal weekday operating condition, in order to best represent exposure concentrations for the occupants. First round samples will be collected during the normal occupied hours for the building. If exposure conditions are less than 24 hours, those samples will be collected using Summa passivated canisters over periods of 8 hours or 12 hours, depending on the actual exposure conditions in each building. Selection of the specific sampling duration for each project site will be discussed in Building-Specific Work Plan Addenda.

The second round of sampling will be conducted with all HVAC systems shut down to evaluate the potential for subsurface VI into buildings without reliance on the ventilation system. For HVAC-off sampling, sample collection will begin at least 24 hours following shut-down of the building ventilation systems and continue while HVAC systems remain off. Since this sampling approach requires keeping the HVAC system off for a minimum of 48 hours, it may not be feasible at certain buildings which are in use seven days per week. In that case, the second round of sampling will be implemented under conditions that would present the greatest VI risk while still being acceptable to the building owners/occupants. Second round samples will be collected over a 24-hour period using passive samplers.

The building owners and occupants will be advised to prohibit activities involving products that typically contain TCE, e.g. painting, waxing or polishing floors or furniture, or application of pesticides or herbicides. Building operators will also be requested to maintain regular operation of the ventilation systems, except during HVAC-off sampling events.

To the extent feasible, potential sources of elevated COCs in indoor air that could interfere with analysis shall be removed at least 24 hours prior to collection of indoor air samples. If not possible, the presence of such potential sources shall be noted in the evaluation of analytical results.

Soil gas sampling will not be conducted when soils are wet from a significant rain event (0.5 inches within 24 hours) or from irrigation. If these conditions are encountered, soil gas sampling will not resume until after waiting 5 days for the soils to drain.

On the day of sampling, the sampler will note conditions that might affect the interpretation of the results under which the sample is taken. These conditions include weather conditions and current building ventilation status. Local measurements of outdoor conditions at a nearby weather station can be obtained from: http://www.wunderground.com/history/.

4.5 Sampling Procedures

4.5.1 Passive Sampling (for Indoor and Outdoor Air)

For each sample location using passive samplers, the collection will follow the steps below.

1. Unpack the sampler from shipping container. Verify that all sampling components are present and the plastic bag containing the cartridge is sealed.
2. Assemble the supporting plate and clip for each sampler including sticking the adhesive label pocket onto the plate in a central position.
3. Prepare a label for the sampler with a discreet sample number and insert it into the pocket on the supporting plate. Indicate the sample number on the chain of custody.
4. Remove the tube from the plastic bag and transfer the cartridge from the tube into the diffusive body being careful not to touch the cartridge.

5. Seat the cartridge centrally in the diffusive body; ensure that not even a half a millimeter is sticking out.

6. Connect the diffusive body to the supporting plate being careful not to bend the cartridge. Keeping the diffusive body vertical during this step will prevent the cartridge from becoming unseated.

7. Affix appropriate signage to notify occupants of sampling in progress and avoid activities which would interfere with sample collection.

8. Promptly and securely suspend the sampler at the specified breathing zone height (refer to site-specific work plans) at the planned sample location. Record the date and time of the beginning of exposure and ambient temperature.

9. At the end of the sampling period, return the cartridge to the original tube and affix the label to the tube such that the barcode is parallel to the axis of the tube. Return the tube to the original box. Record the date and time of the end of exposure.

10. Complete the chain of custody and ensure that air samples are properly labeled. Indicate TO-17 as the analytical method to be used.

11. Return the samplers to the laboratory with the chain of custody. Transport and store the samples at 4°C or less to help minimize diffusion off of the sorbent material.

4.5.2 Summa Canisters (for Indoor Air, Outdoor Air, and Soil Gas)

For samples collected using Summa passivated canisters, the following procedure will be used:

1. Unpack the canisters from shipping container. Verify that all equipment components are present and the canister valve is closed.

2. Mark each canister with a discreet sample number. Indicate the sample number and the flow controller serial numbers on the chain of custody.

3. Remove the brass plug from the canister valve, and attach the vacuum gauge tightly. If using a gauge with a "Tee" fitting, cap the side arm of the "Tee" with the brass plug.

4. Open and close the canister valve. The gauge will register the level of vacuum present. Record this value on the chain of custody for the canister. The initial vacuum of the canister

should be ≥~~>25~~ 28 inches of mercury (" Hg). If the canister vacuum is less than ~~25~~28" Hg, do not use it and arrange for a replacement canister.

5. Verify that the canister valve is closed. Remove the vacuum gauge and replace the brass plug on the canister valve.
6. Remove the particulate filter and pre-calibrated flow controller from the packaging. Place the particulate filter on the flow controller inlet.
7. Remove the brass plug from the canister valve, and attach the flow controller (with the particulate filter) to the canister valve.
8. Place the canister at the specified breathing zone height (refer to Building-Specific Addenda) at the planned sample location. In general, the material of the canister is thermal resistant, but the canisters should be kept out of direct sunlight during sampling.
9. Open the valve and the record sampling start time.
10. Check the canister integrity during the sampling interval. The flow controller often includes a pressure gauge as part of the hardware. This gauge should not be used in place of the vacuum gauge used to record pre- and post-vacuum readings, but can provide a general indication of pressure exchange. For example, 6 hours into a 12-hour sampling event, the canister should contain 2.5 L, and the pressure should be approximately 15" Hg. More than 20" Hg indicates that the canister is filling too slowly; less than 10" Hg indicates the canister is filling too quickly, and corrective action may be necessary, including adjusting the flow, or resampling.
11. At the end of the sampling period, close the valve and record the time, temperature and final canister pressure.
12. Remove the flow controller (with the particulate filter) and attach the vacuum gauge. Open and close the canister valve. The gauge will register the level of vacuum present at the conclusion of sampling. Record this value on the chain of custody for the canister. The final pressure of a 6-L canister should range between 4 and 8" Hg. If the vacuum is greater than 8" Hg, the sample was collected at a lower flow rate. The laboratory will need to apply a greater dilution factor to the sample, resulting in elevated detection limits. If the final

vacuum is less than 4" Hg, either the flow rate was too high or the pressure difference across the flow controller diaphragm was too small. Either condition means that the sample is skewed toward the initial sampling interval. This is a non-linear sample, but it may still be considered valid. If the final pressure is near ambient (less than 1" Hg), it must be considered an invalid integrated sample.

13. Remove the vacuum gauge. Place the brass plug on canister valve and tighten. It is not necessary to over-tighten the fittings. Finger tight plus 1/16 turn is adequate. However, it is essential that all the connections between the canister and the flow controller be tight and immobile by hand. A leak in any one of these connections means that some air will be pulled in through the leak and not through the flow controller. A final pressure near ambient is one indication that there may have been a leak.
14. Repackage the sampling hardware. Complete the chain of custody and ensure that air samples are properly labeled. Indicate TO-15 (SIM) as the analytical method to be used.
15. Return the canisters to the laboratory with the chain of custody. Transport and store canisters at ambient temperature, avoiding temperature extremes and direct sunlight. The canisters will be shipped to the laboratory in the original box.

Sample collection in a crawlspace will follow the same procedures although the height at which the sample is collected will be adjusted based on the configuration of the crawlspace.

4.5.3 Vent Stack Measurement and Sampling

Data collection for vent stacks will include air flow velocity measurements, differential pressure, air temperature and moisture measurements, air sample collection in Summa-passivated canisters, and GC PID measurements. Sampling and measurement of discharge parameters for vent stacks will be completed using the following procedures. A summary of the sampling approach is tabulated in Table 3.

4.5.3.1 Velocity and Differential Pressure Measurements

Before sampling, an initial velocity traverse will be performed at the measurement port using a calibrated Testo 405i Hot Wire Anemometer (see Appendix D) or equivalent instrument to determine a representative gas stream within the pipe cross section. The anemometer will be certified by the vendor before use. All certifications will be provided as an appendix to the Report on Evaluation of Indoor/Outdoor Air and Recommendations (See Section 6.2.1). For each sample location, the velocity measurements will follow the steps below:

1. Unpack the anemometer from shipping container. Verify that all sampling components are present and the battery power is adequate to complete the measurement.
2. Assemble the sample probe and remove the plug from the sample port.
3. Insert the anemometer into the measurement port approximately halfway into gas steam. Rotate the sample probe clockwise until you obtain the highest reading at this location.
4. If a seal is not made between the probe and the measurement port, use~~d~~ Teflon tape to make a snug fit to prevent ambient air from entering the 3" pipe.
5. Move the probe horizontally from side to side to determine highest velocity in the gas steam.
6. Document the location of the probe in the pipe and note the location of the highest and average spatial velocity for a minimum of 3 predetermined traverse points.
7. Record the date, time, technician's identification, model, serial number, average velocity and distance from edge of pipe to this location on the sample log sheet. NOTE: This is the position where each stack sample will be collected (Summa and PID sampling).
8. Remove the anemometer from the stack and proceed to the next measurements.
9. Repeat the measurement at the same sample location within the pipe, following conclusion of the sample collection. Average the results for a final velocity measurement.

After the velocity has been measured, a UEi Test Instrument Dual Differential Input Manometer Model EM152 (Appendix D) or equivalent instrument will be used to measure differential pressure using the following steps:

1. Unpack the manometer from shipping container. Verify that all sampling components are present and the battery power is adequate and correct units are selected to complete the measurement.
2. Prior to use, ensure that the manometer is zeroed. In a non-pressurized area and without hoses attached, press the Hold/Zero button. If the display reads other than zero, press and hold the Hold/Zero button until the display shows '0000'. This indicates that the Zero function has occurred.
3. Attach flexible tube hosing on to either port, leaving the other open to the atmosphere.
4. Insert hose into the same sample point as was measured for the velocity flow.
5. Press the ΔP (Pressure Differential) button and record the pressure differential measurement.
6. Remove the manometer from the sample port and proceed to the next measurement.

This pressure differential measurement may be incorporated in the evaluation as a surrogate for air flow velocity measurements.

4.5.3.2 Temperature and Moisture

After the traverse location has been identified and velocity documented, a Testo 605i Thermo-Hygrometer (see Appendix D) or equivalent instrument will be inserted into the air stream, and temperature and relative humidity readings will be recorded. For each sample location, the temperature and moisture measurements will follow the steps below:

1. Unpack the thermo-hygrometer from shipping container. Verify that all sampling components are present and the battery power is adequate to complete the measurement.
2. Assemble the sample probe and remove the plug from the sample port.
3. Insert the 605i into the sample port to the predetermined measurement location identified following the procedures in Section 4.5.3.1.
4. If a seal is not made between the probe and the sample port, used Teflon tape to make a snug fit to prevent ambient air from entering the 3" pipe.
5. Once the instrument has equilibrated, record the date, time, technician's identification, sensor model, serial number, temperature, and relative humidity on the sample log sheet.
6. Remove the thermo-hygrometer from the stack and proceed to the next measurements.
7. Repeat the measurement at the same sample location within the pipe, following conclusion of the sample collection and the final velocity monitoring.

4.5.3.3 Stack Samples using Summa Canisters

Before the samplers are deployed, the velocity, differential pressure, temperature, and relative humidity of the stack gas will be measured and recorded, following the procedures in Sections 4.5.3.1 and 4.5.3.2. After the traverse location has been established, ~~triplicate~~ stack gas samples will be collected using a modified EPA 18 and ~~1~~six-liter passivated steel summa canisters with 10% replicate samples for quality control. The canisters are cleaned, certified, and evacuated to approximately 29.9 inches of Mercury (Hg) prior to shipment from the laboratory. A flow controller set at approximately 150 ml/min and pre-calibrated gauges will also be requested of~~by~~ the laboratory.

1. Unpack the canisters from shipping container. Verify that all equipment components are present and the canister valve is closed.
2. Mark each canister with a discreet sample number. Indicate the sample number and the flow controller serial numbers on the chain of custody.

3. Remove the brass plug from the canister valve, and attach the vacuum gauge tightly. If using a gauge with a "Tee" fitting, cap the side arm of the "Tee" with the brass plug.
4. Open and close the canister valve. The gauge will register the level of vacuum present. Record this value on the chain of custody for the canister. The initial vacuum of the canister should be ≥~~>25~~ 28 inches of mercury (" Hg). If the canister vacuum is less than ~~25~~28" Hg, do not use it and arrange for a replacement canister.
5. Verify that the canister valve is closed. Remove the vacuum gauge and replace the brass plug on the canister valve.
6. Remove the particulate filter and pre-calibrated flow controller from the packaging. Place the particulate filter on the flow controller inlet.
7. Remove the brass plug from the canister valve, and attach the flow controller (with the particulate filter) to the canister valve.
8. Place the brass cap at the end of the flow controller creating an airtight train, and quickly open and close the canister valve in order to check for leaks. If the needle on the gauge drops, your train is not airtight. In this case, try refitting your connections and/or tightening them until the needle holds steady.
9. Remove protective cap at the sample inlet and connect clean Teflon sample tubing to the sample probe located in the gas stream at the position determined in Section 4.5.3.1
10. Once the sample train has been purged and is leak free, remove the brass cap from the flow controller (valve closed) and attach the probe tubing to the flow controller.
11. Open the canister valve a half turn.
12. Verify and record final initial vacuum of canister (using the flow controller gauge) and sampling start time.
13. When canister fills to the desired end vacuum (5 "Hg), close valve by hand tightening knob clockwise. Record the sample end time.
14. Remove the flow controller (with the particulate filter) and attach the vacuum gauge. Open and close the canister valve. The gauge will register the level of vacuum present at

the conclusion of sampling. Record this value on the chain of custody for the canister. The final pressure of the canister should range between 4 and 8" Hg.

15. Detach the vacuum gauge and replace the brass cap on the canister.
16. Repeat procedure until ~~triplicate~~ summa canister samples have been collected and documented. Replicates shall be collected on 10% of the samples.
17. Repackage the sampling hardware. Complete the chain of custody and ensure that air samples are properly labeled. Indicate TO-15 ~~low-level~~SIM as the analytical method to be used.
18. Return the canisters to the laboratory with the chain of custody. Transport and store canisters at ambient temperature, avoiding temperature extremes and direct sunlight. The canisters will be shipped to the laboratory in the original box.

4.5.3.4 GC PID Screening

At each vent stack sample location, a minimum of three GC PID samples will be collected and analyzed for TCE, concurrent with the collection of the last Summa canister sample, if logistically feasible. Prior to use of the GC PID the field technician will be well versed in its assembly, programming, calibration and operations, specifically following procedures for Tedlar Bag Sampling, presented in Appendix D (FROG 5000 Quick Start Guide and User's Manual Defiant Technologies Inc, 2018 Rev 3 Owner's Manual). The GC PID will be calibrated using a certified TCE standard by the vendor prior to deployment. After delivery, ~~T~~the GC PID should be unpacked and its operation verified prior to transport to the field. This would include installing the appropriate software on the field laptop computer. The procedures using the GC PID are as follows. For ease of use, certain steps of this procedure are written specifically for the FROG-5000 GC PID, and may need to be adapted if another equivalent instrument is used.

1. Unpack the GC PID and verify all the necessary calibrations, user manuals, software and hardware are installed and running properly prior to deployment to the field.

2. Prepare the PID, computer and sampling hardware for operation and turn power onto all its components.
3. The GC PID may be run on battery or on AC power. If run on battery, verify that the battery is fully charged and recharge prior to deployment to the sample site, if necessary. If the GC PID is to be run on shore power, verify that the 12VDC adaptor is available and a 110VAC outlet is within a safe distance and location to use. NOTE: Verify that the extension cord is secured in a safe manner to prevent trips and falls.
4. Turn on the GC PID by sliding the power switch, located on the side of the instrument into the up position. A green light should appear on the unit.
5. Plug the serial port data cable into the data port on the side of the GC PID, as specified in the Quick Start Guide.
6. Run a sample blank, using the FROG Air Sampling Kit, before attempting a sample analysis. A blank run should produce a clean baseline on the chromatograph.
7. Unpack and set up the Method 18 sampling train as specified in EPA Method 18, and detailed in Figure 18-9 of the guidance document (EPA, 2019). Note: Use only new Tedlar bags, never sample into previously exposed bags.
8. Insert the probe into the gas stream and verify that it is set at the predetermined location (see Section 4.5.3.1).
9. Purge the sample, from stack to inlet to Tedlar bag, for approximately 1 minute by attaching the purge vacuum pump to the three way valve immediately prior to the inlet to the Tedlar bag, directing the vacuum flow to the pump and away from the Tedlar bag.
10. Open the valves to the Tedlar bag to sample the gas stream.
11. Turn on the sample vacuum pump to the Method 18 sample train and adjust the flowrate to 500 ml/min and sample for 5-10 minutes, depending on volume of Tedlar bag.
12. Once the approximate sample volume has been collected in the Tedlar Bag, close the inlet to the Tedlar bag, turn off the Method 18 sample vacuum pump and prepare to sample the contents of the bag using the GC PID.
13. Attach the GC PID Tedlar Bag adaptor, following the Quick Start Guide (Appendix D), specifically page 7.

14. Open the Tedlar bag valve and activate the sampling program on the GC PID, see page 6 of the Quick Start Guide (Appendix D).
15. With the FROG connected to the software, start a sample using the large play button in the top toolbar.
16. The FROG will pull a sample from the Tedlar bag for the first sixty (60) seconds of the run, then it will analyze the sample (approximately 5-7 minutes).
17. To view the sample run, select the live data tab in the Ellvin GC software.
18. After FROG is finished analyzing, the software automatically saves the data. A file location with the log number will be displayed at the top of the chromatogram.
19. Run another sample blank before running the second sample from the Tedlar bag.
20. To start a second sample, follow the procedures for loading a sample then repeat Steps 15 through 18.
21. Run another sample blank before running the third sample from the Tedlar bag.
22. Repeat Steps 15 through 18 for the third sample.
23. To analyze a file, verify that the correct calibration is loaded in the calibration tab. If the calibration curve is loaded, vertical blue analyte windows will be present.
24. Look for peaks within the blue analyte windows.
25. Verify that a minimum of three (3) analyses occurred.
26. Run a final blank, and verify that all data have been transferred and recorded.
27. Concentrations for each calibrated analyte peak will be listed.
28. Remove the sample adaptor from the Tedlar bag and proceed to final measurements of velocity, temperature and relative humidity (See Sections 4.5.3.1 and 4.5.3.2).
29. Run a final blank, and verify that all data have been transferred and recorded.

4.6 Quality Assurance/Quality Control Samples

This section discusses additional samples that will be taken concurrently with the other samples to maintain an acceptable level of quality assurance. All quality QA/QC samples will be shipped to the same analytical laboratory and analyzed using the same preparatory and analytical methods used for the other samples.

4.6.1 Field Duplicates

At least one co-located replicate sample will be collected during each sampling placement day for each type of sampling (passive samplers or canisters). The replicate samples are intended to evaluate analytical variability between samples. The co-located replicate sample should be obtained over the same time interval as the original sample. The replicate canisters should be placed within 2 feet of the original sample, at the same elevation, and should be sampled according to the same procedures described above. The precision goal is discussed in the QAPP, Section 2.5 of Appendix C.

4.6.2 Field Blanks

At least one field blank sample will be obtained during each sampling placement day for each type of sampling (passive samplers or canisters). The cartridges of the field blank samplers remain in their packaging although they are shipped along with the other samplers to the site and back to the laboratory for analysis. The methods for sample logging and shipping are the same as those described above. The field blank results are intended to verify sample integrity during field sample collection.

4.6.3 Laboratory Control Samples

Laboratory blanks, laboratory control spikes, and analytical surrogates will be provided and analyzed by the laboratory operating the instrument as described in the analytical method protocol.

4.7 Sample Analysis and Evaluation

Contingent on data needs, all chemicals of concern will be evaluated using USEPA Method TO-15 SIM (six-liter Summa passivated canisters), USEPA Method TO-15 low level (one-liter Summa passivated canisters) and/or USEPA Method TO-17 (passive air samplers). All analytical methods will be conducted by Eurofins Air Toxics. There are ~~eight~~ ten chemicals of concern ~~established in Order No. 91-104 dated June 19, 1991~~ for the Signetics site as discussed in Section 2.5 and listed in ~~(~~Table 4~~)~~.

Note that passive samplers are not recommended for detecting vinyl chloride due to weak sorption and low retention onto sample sorbents (EPA, 2015). However, vinyl chloride was not detected in air samples collected during the previous investigations using Summa canister sampling at the Site (Locus, 2003). Additionally, passive sampling methods are more easily accommodated by occupants in actively used buildings such as those at the Site. Therefore, passive samplers will be employed as the primary sampling tools for evaluating potential indoor VI risks.

Table 4 lists the regulatory limits which the data will be compared against. Laboratory Quality Assurance/Quality Control (QA/QC) data will be reported with the sample data. Laboratory reporting limits, data validation approach and personnel, data quality objectives, and internal laboratory quality control criteria are documented in the QAPP (Appendix C).

The maximum 2017 groundwater concentrations in the shallow "A" aquifer are included in Table 5 for the COCs ~~and~~in addition to PCE and chloroform. Chloroform and PCE ~~is~~ are present at low concentrations in groundwater and ~~is~~ are not identified by the RWQCB as a COC. As discussed in Section 2.5, PCE and chloroform will be ~~Therefore, it is not~~ included in the list of analytes for the VI investigation.

5. Evaluation Procedures

Once collected and analyzed, the potential public health impacts associated with measured levels of site-related chemicals in air will be evaluated with three tiers of data and/or criteria. A flow chart for the evaluation of sampling results is provided in Figure 5.

5.1 Tier 1

Chemicals detected in indoor air will be compared with site outdoor air concentrations for each chemical (site-wide and building-specific) and with local and regional background ambient air concentrations of these chemicals. One outdoor air sample will be collected per day. The outdoor samples will be evaluated statistically to determine the 95% confidence interval against which individual indoor air concentrations will be compared. Additional regional background or reference concentrations will also be considered to provide context regarding long-term regional trends. Indoor air concentrations within or below the 95% confidence interval of outdoor concentrations will be reasonably determined to be background concentrations and not due to VI from groundwater. Indoor air concentrations outside of the 95% confidence interval of outdoor air concentrations will be further evaluated using Tiers 2 and 3 as described below.

5.2 Tier 2

Concentrations which are significantly greater than background will be compared with standard screening levels for acceptable air concentrations. Tier 2 would include short-term and urgent response comparison criteria. These values are generally based on effects other than cancer and are available for short-term exposure durations. For the short-term evaluation, the Agency for Toxic Substances and Disease Registry (ATSDR) provides minimal risk levels (MRLs) for acute (1-14 days), intermediate (14-365 days), and chronic (>365 days) exposure to these chemicals. The

MRL is defined by ATSDR as "an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specific duration of exposure." ATSDR also notes that "MRLs are not intended to define clean up or action levels for ATSDR or other Agencies" (ATSDR, 2019). Additional Tier 2 values for comparisons can be made to the acute and chronic Reference Exposure Levels (RELs) provided by the California Office of Environmental Health Hazard Assessment (OEHHA). OEHHA defines the REL as "the concentration at or below which no adverse health effects are anticipated" (OEHHA, 2016). EPA Regional Screening Levels (RSLs) for non-carcinogenic exposure are also used to evaluate short-term health effects (EPA, 2019a). Based on the Human Health Risk Assessment Note 5 dated 23 August 2014, Human and Ecological Risk Office has short term "accelerated response" and "urgent response" action levels for TCE (DTSC, 2014). The commercial 8-hour work day values will also be included as part of the Tier 2 evaluation. Tier 2 comparison criteria are listed in Table 4 for the chemicals of concern at this site. As specified in the ASAOC Appendix C, Section IV.C, the applicable Tier 2 criteria for TCE will based on the building occupancy. For COCs other than TCE, the lowest Tier 2 criteria listed in Table 4 will be used for comparison in this evaluation. All data evaluated against Tier 2 criteria will also be evaluated against Tier 3 criteria.

5.3 Tier 3

Tier 3 criteria are derived based on consideration of long-term carcinogenic effects in a commercial setting. Air sample results are compared to the Environmental Screening Levels (ESLs) published by the RWQCB (RWQCB, 2019), as well as EPA Regional Screening Levels (RSLs) for carcinogenic exposure (EPA, 2019a). It is important to note that these values are not intended to identify "unsafe" conditions. Rather, the screening levels are used to identify areas or buildings that warrant further evaluation. Tier 3 comparison criteria are listed in Table 4 for the COCs at this site. The analytes for the VI evaluation are the COCs identified by the RWQCB in the regulatory Orders.

5.4 Evaluation Process for Potential Vapor Intrusion

A flow chart for the evaluation of sampling results using the three tiers is provided in Figure 5. Draft sample results will be initially compared to EPA's accelerated response action level for TCE. If the results exceed that level, EPA will be notified within 48 hours of receipt of analytical results. Data will then be reviewed and validated, with priority given to higher concentrations, if found.

The results will then be compared with Tier 1 (background) criteria to determine if the indoor air concentrations are statistically different from outdoor and background sample results. If not, then indoor air concentrations would not be significantly affected by VI, and no further action is anticipated. Likewise, if the results are lower than Tier 3 (long-term) screening levels, then it can be concluded that the concentrations do not pose health concerns, and no further action is anticipated. However, all data evaluated against Tier 2 and Tier 3 criteria will be used for the evaluation of risk management activities, and later in the Report on Evaluation of Indoor/Outdoor Air and Recommendations (see Section 6.2.1).

Results that exceed the Tier 1 and Tier 3 screening levels will be compared against Tier 2 (short term) to determine whether interim measures should be taken to temporarily mitigate the building. In either case, results that exceed the Tier 2 or Tier 3 screening levels will be confirmed through another sampling event, after a more thorough inspection of the building to search for potential indoor air sources and preferential VI pathways. Additional sample locations may be added during the confirmation sampling to provide more detailed information on potential sources or pathways. Confirmation samples may be analyzed on an accelerated schedule. After confirmation samples are collected, the data will be evaluated to consider whether observed concentrations result from VI. This will include evaluation of other potential indoor sources of the detected chemicals, and comparison of sample results against pathway samples. If chemical concentrations are absent in pathway samples collected from crawlspaces and subfloor areas (or significantly less than concentrations found inside living spaces), this would indicate that the VI pathway is incomplete or insignificant, and indoor concentrations, if observed, would be originating from other sources. In this case, no further action is anticipated.

If confirmation sampling indicates that VI is a potential source for the indoor air concentrations, mitigation measures and/or further monitoring will be evaluated and implemented. Concentrations that are above the Tier 3 screening levels but below Tier 2 screening levels are within EPA's risk-protective range. Buildings with concentrations in this range may be either directly addressed with mitigation, or may be further evaluated to determine the variability of the measured concentrations.

5.5 Mitigation Considerations for Potential Vapor Intrusion

As specified in the ASAOC, mitigation measures would be implemented immediately (within a few days) for a confirmed vapor intrusion occurrence of TCE above the urgent mitigation criteria listed in Table 4 (21 $\mu g/m^3$ for a 10-hour commercial occupancy). Short-term or interim mitigation measures would be implemented promptly (within weeks) for a confirmed vapor intrusion occurrence of TCE above the short-term mitigation criteria listed in Table 4 (7 μg/m3 for a 10-hour commercial occupancy). For COCs other than TCE, short-term mitigation measures will be evaluated for confirmed vapor intrusion occurrences above the short-term criteria listed in Table4.

Pre-emptive mitigation measures will be evaluated where chemical concentrations related to vapor migration are in exceedance of 5 µg/m^3 for TCE as specified in the ASAOC (Appendix C, Section IV.D). Mitigation options may also be considered if action levels are exceeded in pathway samples. If available information collected during the pre-sampling activities demonstrates a potential for VI issues that could be addressed, pre-emptive mitigation options may be considered and implemented prior to sampling. When considering mitigation options, the extent and location of concentrations will be evaluated as described above. Concentrations in a single room or isolated area are typically addressed differently than elevated concentrations in the building air as a whole. If warranted, mitigation measures will be proposed in the Report on Evaluation of Indoor Air and Recommendations and submitted to EPA. If action levels are not exceeded in ambient or pathway air samples, then no mitigation measures would be recommended. In particular, if indoor air concentrations are consistent with outdoor background concentrations, mitigation measures would not be effective.

5.5.1 *Interim Mitigation Measures*

If indoor air TCE concentrations exceed the short-term urgent or accelerated response action levels, early or interim mitigation measures will be evaluated and implemented to address concerns for building occupants, and the effectiveness of the mitigation measures will be confirmed through re-sampling. The following interim response actions will be considered to mitigate short-term exposure:

- Increasing building pressurization and/or ventilation mechanically with fans or the building ventilation system by increasing outdoor air intake.
- Installing and operating engineered, sub-floor exposure controls (sub-slab and/or crawlspace depressurization).
- Sealing and/or ventilating potential conduits where vapors may be entering building.

- One-way drain valves will be installed if none are present in basement floor drains or sinks.
- Temporary relocation of building occupants until a time that indoor air concentration levels are mitigated below urgent action levels.
- Indoor air purifiers or adsorption systems such as carbon filtration.

Not all of these options will be feasible for every scenario. The most appropriate choice will be selected considering the building characteristics and cooperation of the occupants.

5.5.2 Long-term Mitigation Measures

The following potential long-term mitigation systems are considered to mitigate TCE long-term exposure, along with plans for long-term operation and monitoring:

- Improved operation and maintenance of the HVAC systems to enhance circulation.
- Sealing and/or ventilating potential conduits where vapors may be entering building.
- Installing vapor barriers beneath buildings with crawlspaces.
- Installing a sub-slab venting layer beneath buildings with crawlspaces, with either passive or active ventilation.

Remedial alternatives may be developed as a combination of one or more of the remedial technologies listed above. Evaluation of remedial alternatives will be based on multiple criteria that include overall protection of human health and environment, long-term or short-term effectiveness, implementability, etc. Further evaluation of the alternatives may be addressed in the Report on Evaluation of Indoor Air and Recommendations as needed where mitigation efforts are found to be necessary.

Some relevant references provided by EPA for long-term mitigation measures are as follows:

- Department of Toxic Substances Control California Environmental Protection Agency (DTSC), 2011. *Vapor Intrusion Mitigation Advisory, Final, Revision 1,* October, https://dtsc.ca.gov/SiteCleanup/upload/VIMA_Final_Oct_20111.pdf
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In the future, these mitigation measures may be revisited should site conditions change such as new commercial or residential development. In this case, an evaluation based on current property use would be conducted and, if necessary, a mitigation plan would be developed in collaboration with the EPA and developers.

5.5.3 Operation and Maintenance

Operation and Maintenance (O&M) plans are necessary to verify whether the mitigation system is meeting performance standards. O&M plans for of interim or long-term mitigation measures can vary based on the alternatives used. O&M Plans will include the following:

- Plans for post-mitigation indoor, outdoor and pathway air sampling, including post-mitigation sampling events during the winter heating season
- Procedures for operation of the mitigation system including identification of system components
- Procedures for maintenance and inspection of the mitigation system
- Maintenance and inspection frequency

- Procedures for collecting field measurements necessary for gauging system performance such as vacuum readings, pressure differentials, and flow rates

The O&M inspection frequency depends on the mitigation measure in-place. Active mitigation measures such as enhanced ventilation and air purification will generally be accompanied by more frequent inspections. Passive mitigation measures such as barriers and conduit sealing would require fewer inspections. The long-term inspection and sampling frequency for mitigated buildings will be established in the Building-Specific Mitigation Completion Report (see Section 6.2). Examples of mitigation systems requiring O&M are as follows:

- Sub-slab Pressurization & Surface Coating: Long-term verification includes monitoring of system components (blower, control) to ensure operation and pressure readings in sub-slab.
- Sub-slab Pressurization & Synthetic Vapor Barriers: Similar to alternative above.
- Sub-slab Depressurization: Long-term verification includes monitoring of system components (blower, controls, etc.) to ensure operation.
- Vapor Barrier and Passive Venting: Long-term verification would consist of collection of indoor air samples.
- Ventilation: Ventilation systems would be inspected annually to ensure optimal operations efficiency. Inspection results would be provided to the building owners/occupants and also included in monitoring reports, as appropriate. Long-term operation and monitoring includes obtaining HVAC service reports to verify operations and repairing defective HVAC components.

5.6 Evaluation Process for Vent Stack Sample Results

Vent stack discharge data from sub-slab depressurization systems (SSDS) and sub-membrane depressurization systems (SMDS) will be used to ~~evaluate the applicability of~~determine whether BAAQMD regulations are substantively met. Data will be compared to BAAQMD regulations including, but not limited to, BAAQMD Regulations 2 and 8. BAAQMD staff may be consulted to determine if analysis of COCs is sufficient for evaluation against exemption provisions of the regulations; if additional VOCs are required by BAAQMD for data evaluation, those will be included in the analytical suite. Although applicability will be evaluated based on the entirety of BAAQMD regulations, the following numerical criteria will be included in data evaluation.

BAAQMD Regulation 2, Rule 5 (New Source Review of Toxic Air Contaminants) provides for the review of new and modified sources of air emissions to evaluate potential public exposure and health risk, mitigate potential risks, and improve the level of emissions control. Per Regulation 2-5-110, Regulation 2, Rule 5 does not apply if, "total project emissions" are below acute and chronic inhalation reference exposure levels (RELs) (Table 2-5-1) for each contaminant listed. The RELs are also used to determine if a Health Risk Assessment (Regulation 2-5-401) would be required. Therefore, vent stack discharge concentrations will be compared to Table 2-5-1 RELs. The BAAQMD interpretation of "total project emissions" for the purposes of data evaluation may require additional investigation with the help of BAAQMD staff. As discussed in Section 4.2.2, VI mitigation system vent stack discharges may be evaluated in conjunction with all Signetics site VI mitigation system vent stacks, air emissions from the GWTS air stripper and/or a similar investigation at the adjacent OOU site, if/as applicable.

Regulation 8, Rule 47 identifies emission control requirements for organic compound emissions from air stripping and soil vapor extraction systems. Per Regulation 8-47-109, emission control requirements (Regulation 8-47-301) for specific compounds (benzene, vinyl chloride, PCE, methylene chloride and/or TCE) do not apply to operations that 1) emit no more than one of the specific compounds; and 2) do not exceed the following emissions: 0.05 pounds per day (lb/d) benzene, 0.2 lb/d vinyl chloride, or 0.5 lb/d TCE, PCE or methylene chloride. Per Regulation 8-47-113, emission control requirements (Regulation 8-47-301) for specific compounds do not apply to operations with total emissions of less than 1 pound per day of the specific compounds if the petition process (Rule 8-47-402) has been conducted. Therefore, vent stack discharge will also be compared to these thresholds and in conjunction with other air discharges at the Signetics and/or OOU site, if/as applicable.

5.7 Evaluation Process for Outdoor Air Samples

Results from the onsite and offsite outdoor samples will be reviewed with respect to prevailing wind speed and direction and evaluated with the use of statistical analysis appropriate to the sample size and distribution (e.g. ANOVA or Wilcoxon Rank Sum). Statistical analysis tools such as EIM or ProUCL may be employed if needed. If offsite outdoor concentrations are shown to be statistically significantly similar or higher than the onsite outdoor concentrations, this would be an indication that there are no significant impacts to outdoor air, either through the installed mitigation/treatment systems or through direct VI from subsurface to outdoor air. If onsite outdoor air concentrations are statistically significantly elevated compared to the upwind offsite outdoor air concentrations, further evaluation and/or mitigation will be implemented to identify and address the specific source for the elevated concentrations, with consideration of vent stack sampling results (Section 5.6). These measures may include retrofits to mitigation or treatment systems to reduce discharge of COCs to the atmosphere.

6. Data Management, Reporting & Scheduling

6.1 Data Management

Compilation and submittal of data related to the Signetics site is discussed in the QAPP in Appendix C, Sections 2.7 and 3.10.

6.2 Reporting

After samples are collected per the building-specific work plan addenda, site-wide results will be documented and evaluated in the ASAOC milestone report: Report on Evaluation of Indoor/Outdoor Air and Recommendations. Results will also be included in a site-wide progress report: the Vapor Intrusion and Mitigation Activities Report, to facilitate data sharing while milestone reports are being developed.

If mitigation is implemented at Signetics, Building-Specific Mitigation Completion Reports would be developed for each applicable building, documenting mitigation and post-removal site control measures.

6.2.1 Report on Evaluation of Indoor/Outdoor Air and Recommendations

The evaluation process and mitigation considerations described above will be documented in a Report on Evaluation of Indoor/Outdoor Air and Recommendations. The report will include site-wide results from the indoor air sampling and summarize findings, document risk-management activities if taken, and recommend mitigation measures, monitoring plans, and institutional controls, if applicable. The report will also include site-wide results from the outdoor air and vent stack sampling, calculated VOC discharge from the groundwater treatment system, and make recommendations based on the evaluation process discussed in Section 5.5. All project records (e.g. field notes and instrument certifications) to be reported will be included in an appendix as described in Section 2.7 of the QAPP. Upon approval of the report, implementation of the recommendations will commence within 30 days. While not required or specified by the ASAOC, the recommendations may include Building-Specific Mitigation Plans, a document demonstrating the mitigation system design to the property owner and the installation contractor. Modifications to the Mitigation Plans may be required by the property owner, which may delay the implementation of the recommendations. Any delays to implementation of the recommendations would be communicated to the EPA.

6.2.2 Building Specific Mitigation Completion Reports

If mitigation measures are implemented, a completion report will be prepared for each building. The Building-Specific Mitigation Completion Report will include requirements for post-removal site controls consistent with Sections 300.415(*l*) and 300.5 of the NCP and "Policy on Management of Post-Removal Site Control" (OSWER Directive No. 9360.2-02, Dec. 3, 1990) and detail building-specific risk management activities and mitigation measures developed and implemented. In addition, the following information will be included:

- Operation and Maintenance Plans for mitigation systems
- Required City building/safety permits
- Occupant Information Sheets
- As-built drawing for the mitigation systems installed

Post-removal site control activities in the form of O&M inspections and post-mitigation sampling will be conducted until sufficient data is collected demonstrating mitigation measures are no longer necessary to maintain risk-based concentrations of TCE indoor air. The completion report will include a termination plan for building-specific post-removal site control activities.

6.2.3 Vapor Intrusion and Mitigation Activities Report

Vapor intrusion activities at the Signetics Site will be summarized in a report to the EPA. Examples of vapor intrusion activities include, but are not limited to, indoor air sampling, onsite outdoor air sampling, vent stack sampling, mitigation system O&M inspections, post-mitigation sampling, confirmation sampling (if applicable), and mitigation measures. These reports will follow this general outline:

1. Introduction and property background
2. Summary of vapor intrusion activities within the reporting time frame (e.g sampling, O&M, community involvement, implementation of interim or long-term mitigation measures) and supporting documentation
3. Delays and Problems Encountered
4. Schedule of future vapor intrusion activities

The following sampling related supporting documentation will be included in the report:

- Sample location figure(s)
- Laboratory reports
- Field notes
- Analytical data tables by building

The following mitigation system O&M related supporting documentation will be included in the report, as appropriate:

- Figure showing mitigated properties and mitigation type

- Field parameter data tables (i.e. vacuum, temperature, pressure differentials, flow rates as specified in the building specific O&M plans)
- O&M inspection forms and field notes

Mitigation system O&M documentation must demonstrate the effectiveness of engineering controls and whether performance standards are being met. Performance standards are system specific and shall be detailed in building-specific O&M Plans (see Section 5.5.3). If the system is not meeting performance standards, corrective action shall be taken as soon as possible after the finding, preferably during the O&M event. If corrective action cannot be taken during the O&M event, a plan for implementing corrective action shall be developed. All corrective action shall be documented in field notes and summarized in the report (delays and problems encountered section).

Vapor Intrusion and Mitigation Activities Reports will be submitted to the EPA 45 days following the quarter of a sampling or O&M inspection event, when applicable. The frequency of reporting will be based on the recommendations made in the Building-Specific Addenda, Building-Specific Mitigation Completion Report and/or O&M Plan. An Annual Post-Mitigation Vapor Intrusion Report will also be submitted to the EPA within 60 days of the fourth quarter (in lieu of a fourth quarter report).

The pre-emptively mitigated buildings discussed in Section 2.6 will be grandfathered into the reporting cycle until formal building specific evaluations and mitigation measures, if applicable, are conducted under the ASAOC and this Work Plan. The next O&M inspection is scheduled for fourth quarter 2020, thus reporting for 440 Wolfe and 815 Stewart Drive will be due in 2020 Annual Post-Mitigation Vapor Intrusion Report.

6.3 Milestones and Reporting Schedule

The following milestones and reporting schedule are anticipated:

- Within 21 days of EPA approval of the Vapor Work Plan, building survey implementation will commence, assuming that building access has been granted.
- Within 30 days following the completion of each building survey, Building-Specific Vapor Work Plan Addenda will be submitted to the EPA.
- Within 21 days of EPA approval of the Building-Specific Work Plan Addenda, indoor air sampling will commence. If appropriate, immediate or short-term mitigation or interim response activities will be performed as approved by the EPA.
- Within 45 days of EPA approval of completion of indoor air sampling, a Report on Evaluation of Indoor/Outdoor Air and Recommendations will be submitted to the EPA.
- Within 30 days of EPA approval of the Report on Evaluation of Indoor Air and Recommendations, implementation of initial or additional Building-Specific Risk Management and Mitigation Measures, Monitoring Plans, or Institutional Controls, if appropriate, will commence.
- Within 45 days of EPA approval of completion of Building-Specific Risk Management and Mitigation Measures, Monitoring Plans, or Institutional Controls, a Building-Specific Mitigation Completion Report for each building will be submitted to the EPA.
- Throughout implementation of the above activities, Vapor Intrusion and Mitigation Activities Reports will be submitted quarterly to EPA on 15 May, 14 August, 14 November, and March 1 of each year per Section 6.2.3.

The schedule may also be revised as needed to accommodate requests from the property owner or occupants (e.g. to arrange sampling when the building will not be in use). EPA will be notified in accordance with the ASAOC of any such schedule changes.

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